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Lower crustal gabbro and hornblendite in the eastern Gangdese arc: Constraint on the metal source of the postcollisional porphyry Cu deposits in southern Tibet

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Genesis of postcollisional Cu-forming granodiorite porphyry intrusions in the Gangdese Cu belt in southern Tibet has been generally linked to melting processes of subduction-modified mafic lower crust, through which ore-forming metals and sulfur were mainly derived from remelting of sulfide phases that were introduced during precollisional arc magmatism. However, such hypothesis has not been directly tested. In this study, we report a suite of gabbro to hornblendite from the Late Cretaceous Lilong mafic batholith of the eastern Gangdese magma arc. The gabbro mainly consists of orthopyroxene, clinopyroxene and amphibole, whereas the hornblendite comprises clinopyroxene and amphibole. Microprobe analysis indicates that the orthopyroxene, clinopyroxene and amphibole from the gabbro are respectively enstatite, diopside and tschermakite in composition, whereas the clinopyroxene and amphibole from the hornblendite are respectively diopside and magnesiohastinsite in composition. Crystallization temperatures and pressures of these minerals were estimated using thermobarometers of (Putirka,2008;Ridolfi,2010;Schmidst,1992),and the calculated results indicate: (1) the clinopyroxene crystallized at higher temperatures (1180-1218 ℃) and pressures (7.6-10.2 kbar) than amphibole (temperature: 906-943 ℃, pressure: 7-8kbar) in the gabbro, and (2) the amphibole in the hornblendite crystallized at high temperature of 950-990 ℃ and pressure of 7.4-8.2 kbar. The results reflect that the emplacement of the gabbro to hornblendite was at a paleodepth of >30 km, indicating they used to be middle to lower crustal rocks. Our statistics indicates that sulfide minerals in these rocks mainly consist of chalcopyrite, pyrrhotite and pyrite, with total content of <0.5 wt.%. Simple modeling calculation indicates that partial melting of such lower crustal rocks cannot produce a granodioritic magma with high Cu contents (50-100 ppm), which implies that the Oligocene to Miocene porphyry Cu mineralization in southern Tibet probably has other sources of Cu and probably S than lower crust as originally considered.